



Numerical Methods for Image Registration (Numerical Mathematics and Scientific Computation)

Jan Modersitzki

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Based on the author's lecture notes and research, this well-illustrated and comprehensive text is one of the first to provide an introduction to image registration with particular emphasis on numerical methods in medical imaging. Ideal for researchers in industry and academia, it is also a suitable study guide for graduate mathematicians, computer scientists, engineers, medical physicists, and radiologists.

Image registration is utilised whenever information obtained from different viewpoints needs to be combined or compared and unwanted distortion needs to be eliminated. For example, CCTV images, ultrasound images, brain scan images, fingerprint and retinal scanning.

Modersitzki's book provides a systematic introduction to the theoretical, practical, and numerical aspects of image registration, with special emphasis on medical applications. Various techniques are described, discussed and compared using numerous illustrations.

The text starts with an introduction to the mathematical principles and the motivating example of the Human Neuroscanning Project whose aim is to build an atlas of the human brain through reconstructing essential information out of deformed images of sections of a prepared brain.

The introduction is followed by coverage of parametric image registrations such as landmark based, principal axes based, and optimal affine linear registration. Basic distance measures like sum of squared differences, correlation, and mutual information are also discussed.

The next section is devoted to state-of-the-art non-parametric image registrations where general variational based framework for image registration is presented and used to describe and compare well-known and new image registration techniques. Finally, efficient numerical schemes for the underlying partial differential equations are presented and discussed.

This text treats the basic mathematical principles, including aspects from approximation theory, image processing, numerics, partial differential equations, and statistics, with a strong focus on numerical methods in image processing. Providing a systematic and general framework for image registration, the book not only presents state-of-the-art concepts but also summarises and classifies the numerous techniques to be found in the literature.

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